

Can We Really Scrub Carbon Dioxide From the Atmosphere?

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Body

Welcome to the Climate Fwd: newsletter. The New York Times climate team emails readers once a week with stories and insights about climate change. Sign up here to get it in your inbox.

This week: Are we ready to remove carbon dioxide from the air? Would drone deliveries help or hurt the environment? And will Canada push the United States on climate change?

Your burning climate question: Can carbon dioxide be removed?

Do you have questions about climate change? We're answering them in this newsletter. Send us yours via the form at the bottom of our climate Q. and A. This one was sent to us from Walter Beinecke in Manchester-by-the-Sea, Mass.:

What are the leading/viable technologies to remove carbon dioxide from the atmosphere?

Removing carbon dioxide that is already in the air is seen as a potential way to combat global warming. There are various approaches, lumped together as “negative emissions technologies” to distinguish them from technologies that reduce or eliminate emissions from power plants and other sources.

In theory, reducing the concentration of heat-trapping carbon dioxide in the atmosphere might be one way to keep the world under the two-degree Celsius target for warming established by the 2015 Paris climate agreement. But in practice, removing carbon dioxide is far from simple. There are major questions about scale, cost, speed and energy requirements. In most cases, the carbon dioxide that was removed would have to be buried underground indefinitely — and carbon storage technologies have only been deployed on a small scale so far.

Some removal technologies are more fanciful than others, but as for which are most viable, it could be argued that none are, at least not yet. In a report last month, the European Academies Science Advisory Council offered a pessimistic outlook for carbon removal, saying that it offered only “limited realistic potential” to have a climate impact. The authors argued that the world should not count on removal technologies to make up for a failure to sharply reduce or eliminate emissions in the first place.

There are five major approaches to carbon dioxide removal:

Plant more forests. Trees remove carbon dioxide naturally, incorporating it into their tissues as they grow. Worldwide, forests store about one billion to two billion tons of carbon annually, offsetting a chunk of the roughly 10 billion tons emitted by human activity. Reforestation and afforestation, properly managed, could remove a lot more

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and keep it out of the atmosphere. But planting forests is slow work — as Icelanders know well — and requires a lot of land. The world is currently much better at cutting down forests than planting new ones.

Crush a lot of rock. This technique is called enhanced weathering, and is based on the fact that some types of rock weather by naturally combining with carbon dioxide in the air or water. One suggested approach would use the mineral olivine, which is plentiful, crushing it into fine sand and spreading it on land, perhaps along coastlines. But mining, crushing and transporting the billions of tons needed would be expensive and energy intensive. And the carbon removal would still be exceedingly slow.

Burn plants for energy and capture the carbon dioxide. In this high-tech approach, called bioenergy with carbon capture and storage, or BECCS, vegetation would be used to naturally remove carbon dioxide. The vegetation would then be burned in a power plant and the carbon dioxide in the exhaust gases would be captured and stored. So far there are only a handful of working BECCS projects; others have been canceled. Among the many questions about the technology is whether emissions are really negative if the carbon cost of growing and harvesting the vegetation is taken into account.

Sprinkle iron in the ocean. Like enhanced weathering, fertilizing the ocean by putting iron particles or other nutrients in the water is among the more far-fetched approaches. The idea is that the nutrients would stimulate the growth of tiny marine plants called phytoplankton, which would incorporate carbon dioxide as they grew and then sink to the bottom of the ocean when they died, taking the carbon with them. Generally, however, putting large amounts of metal or chemicals into seawater is considered ocean dumping. There have been only a few tests of the idea, one of which was conducted without scientific oversight off Western Canada in 2012 under the pretense of helping a native Canadian community improve its salmon catch.

Suck carbon dioxide out of the air. There has been a significant amount of research into “direct air capture.” Much of the technology is similar to what is used in carbon capture projects at power plants: chemicals bind with carbon dioxide molecules and then are heated or otherwise treated to release them for capture. Several companies, including Carbon Engineering and Climeworks, have developed machines to do this. But carbon capture at a fossil-fuel plant, where carbon dioxide can make up perhaps 5 to 10 percent of the exhaust gases, is one thing. Doing it from the air is another. For all the rightful concern about rising carbon dioxide levels, the gas still makes up only about 0.04 percent of the atmosphere. Removing a significant amount of it would involve moving huge volumes of air through thousands upon thousands of capture machines, and powering the machines for decades.

If drone delivery becomes a reality, is that good for the planet?

On Dec. 7, 2016, an Amazon Prime Air drone flew 13 minutes from a warehouse in Cambridgeshire, England, to a customer’s home a couple of miles away, where it delivered an Amazon streaming device and a bag of popcorn. The flight was among the first attempts in the race to make drone delivery a reality, which has also attracted companies like Alphabet and U.P.S. Even before Amazon’s inaugural flight, 7-Eleven had already dispatched doughnuts in Reno, Nev., and Domino’s landed chicken pizzas near Auckland, New Zealand.

In a study published this year in Nature Communications, researchers compared the potential environmental impacts of these pilotless couriers with those of existing ground delivery systems. They found that small drones designed to carry packages weighing about a pound or less had a smaller carbon footprint per delivery than diesel and even electric trucks. But bigger drones carrying packages of up to 18 pounds were likely to generate more planet-warming emissions over all.

“My first impression was that if you were really going to do this, it would be a terrible idea for the environment,” said Joshua Stolaroff, an environmental scientist at Lawrence Livermore National Laboratory in California and the lead author of the study. “So I was somewhat surprised that the results were mixed the way they were,” he said. “There are opportunities for drones to save energy and emissions.”

While drones could consume less energy per package than diesel-powered delivery trucks, additional warehouses would be needed to service those drones, negating at least some of the environmental benefits. To blanket the San

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Francisco Bay Area, for example, researchers estimated that 112 warehouses and way stations would be needed to house products and drones. Those spaces would need to be cooled and heated, releasing further emissions.

"If you want to properly consider the impacts of drones, you have to consider the whole life cycle," Dr. Stolaroff said.

(The study did not assess ideas like trucks that launch drones or flying drone warehouses, but the researchers said they would consider those types of scenarios in future work.)

In every scenario, however, researchers found that getting something delivered by a drone would be better for the environment than driving to a store to pick it up yourself. "Taking your whole two-ton steel vehicle four miles round trip to get an item is way worse," unless you can complete multiple errands on the same trip, Dr. Stolaroff said.

While drone delivery has yet to be rolled out on a mass scale, Amazon said in a statement that it was committed to offering a delivery option that would "benefit both customers and the planet."

"With drone delivery," Dr. Stolaroff said, "we have an opportunity that we don't usually have with new technology, which is to consider their impacts before they are widely deployed."

Canada's environment minister says she won't back down

Catherine McKenna, Canada's environment minister, was in New York last week to discuss ocean health and climate change with city officials and business leaders. We had a chance to talk about the Group of 7 meeting of leaders of major industrialized nations, to be held in Charlevoix, Quebec, in June.

Last year in Italy the Group of 7 meeting was a flash point on climate change. The Trump administration refused to join the other six nations in reaffirming a commitment to reducing greenhouse gas emissions through the Paris agreement. Ms. McKenna told me she hopes to avoid another such split with the United States, but she said her country won't back down on its commitment to the accord. Here's a portion of our interview, edited and condensed for clarity.

How big a deal is climate change going to be at the G-7?

Climate change, oceans and energy are our top priorities. It is really important. We understand that you need to keep the momentum on climate action. Oceans are a real focus for the prime minister. He really is looking for something along the lines of a zero-waste charter. And I think there's a lot of momentum with that. We've had good discussions with the U.S. There's interest in doing something on plastics. We know that we may have more plastic than fish in the ocean by 2050, which is a really sad state for the ocean.

Are you actively looking for environmental areas that are not climate change where you can find some common ground with the Trump administration?

I think plastics is certainly one where we need to be doing a lot more, and there is some appetite in the United States. Look, clearly in Canada climate change is a top priority. I'm the first minister of energy and climate change, and we've been very active domestically and internationally, so we're not going to shy away from that.

Last year the G-7 negotiations were quite antagonistic on climate change. Do you anticipate the same dynamic?

I'm certainly hopeful not. We certainly learned some lessons there.

Will Canada insist on affirming the Paris agreement in a Group of 7 joint statement?

Spending all your time negotiating a communiqué as opposed to just moving forward and talking about action is probably not where you necessarily want to be. I'm more interested in how we get serious action. Climate change is the biggest issue we face and we're going to continue having conversations about it. I'm always hopeful.

We'd love your feedback on this newsletter. Please email thoughts and suggestions to climateteam@nytimes.com

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